UDC 615.1:658.7
DOI: 10.15587/2519-4852.2023.286741

METHODOLOGICAL APPROACHES TO ASSESSING DIGITAL MATURITY OF LOGISTICS ACTIVITIES OF PHARMACEUTICAL ENTERPRISES

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The aim: *development of methodological approaches to assessing the digital maturity of the logistics activity of a pharmaceutical enterprise and elaboration of the proposed methodology on the example of those domestic enterprises that have a developed logistics system and some experience in the implementation of digital technologies in logistics activities.*

Materials and methods: *Research was conducted using databases on the Internet: the European Center for Information Systems Research, the European Medicines Agency, and scientific and metric databases – Scopus, Web of Science. Logical, systematic analysis and synthesis, graphic methods of research, and methods of mathematical and statistical analysis (expert, pair correlation and taxonomic) were used.*

The results. *An analysis of the state of implementation of digital technologies was carried out on the example of domestic pharmaceutical enterprises, which have been the leaders of the pharmaceutical market in recent years. It is substantiated that the assessment of digital maturity is a mandatory prerequisite for the digital transformation of pharmaceutical market entities. The existing models of digital maturity assessment are analyzed, and their shortcomings are identified. Based on this, a methodology for assessing the digital maturity of the logistics activities of pharmaceutical enterprises is proposed. An algorithm for the practical implementation of the methodology for assessing the digital maturity of the logistics activity of pharmaceutical enterprises is proposed. Based on the application of the proposed methodological approaches for assessing digital maturity using the taxonomic method, the calculation of the integral indicator of the level of digital maturity of the logistics activity of domestic pharmaceutical enterprises was carried out. The priorities for the implementation of digital technologies in the logistics activities of pharmaceutical enterprises were determined depending on the degree of their digital maturity.*

Conclusions*. It has been proven that the digital transformation of the logistics activities of pharmaceutical enterprises is a complex process that must consider many factors of the internal and external environment of the pharmaceutical enterprise. It is impossible to form a strategy and make decisions about investing in digital technologies without first assessing your real opportunities and weak points of the enterprise. That is why the assessment of the existing level of digital maturity is an important step on the way to the systematic digitalization of the logistics activities of a pharmaceutical enterprise. The proposed methodical approaches to assessing the digital maturity of the logistics activity of pharmaceutical enterprises will allow to form a holistic view of the real level of digital maturity of a certain enterprise and its deviation from the desired state, determine the priority directions for increasing the level of digital maturity, based on the specifics of the logistics activity of a particular pharmaceutical enterprise, and develop a sound digital strategy to improve the performance of both the individual business and the pharmaceutical supply chain*

Keywords*: pharmaceutical industry, pharmaceutical enterprise, logistics activity, digitalization, digital maturity, digital technologies*

How to cite:
Lisna, A., Posilkina, O., Litvinova, E., Bratishko, Y., Gladkova, O. (2023). Methodological approaches to assessing digital maturity of logistics activities of pharmaceutical enterprises. ScienceRise: Pharmaceutical Science, 4 (44), 76–88. doi: http://doi.org/10.15587/2519-4852.2023.286741

1. Introduction

In recent years, digital technologies (DT) have had a serious impact on the lives of millions of people, and various sectors of the economy actively use these technologies to increase the speed, accuracy and efficiency of information processing, to automate processes related to the performance of routine, repetitive and monotonous operations, thanks to which there is an opportunity to significantly increase the efficiency of enterprises.

Today, DTs are actively implemented in the pharmaceutical industry, primarily in the areas of information exchange, bar coding of pharmaceutical products, management accounting, statistical data processing, creation of web platforms to support and improve the provision of pharmaceutical care and services, discussion of initiatives in the field of health care [1, 2]. In addition, DT allows you to automate the processes of management, marketing and logistics, which significantly affects the financial aspects of the activities of pharmaceutical market entities (PME) [3].

Pharmaceutical logistics is an important and integral component of pharmacy. In the conditions of high

competition in the pharmaceutical market, "pressure" from customers, and the complex organizational basis of pharmaceutical logistics processes, pharmaceutical enterprises (PEs) are constantly trying to improve logistics business processes to fully satisfy the needs of consumers and increase their competitiveness [4].

The study of the domestic and global experience of using DT in PE logistics activities made it possible to generalize the advantages of their use for pharmacy [5–7]: increasing the reliability of the functioning of pharmaceutical supply chains (PSC); increasing the level of their safety and security; reduction of logistics costs and losses; reducing the risks associated with entering the chains of falsified and counterfeit pharmaceutical products; increasing transparency of business processes and, as a result, increasing trust between partners participating in the chain; increasing the level of privacy and security of information that is a commercial secret; increasing guarantees regarding the preservation of the quality of medicinal products at all stages of their promotion from the manufacturer to the consumer; increasing labor productivity and the ability to deal with such urgent problems as: limited access to data in some PEs that use functionally different information platforms and repositories; the lack of modern automated management systems in many PMEs capable of promptly analyzing the conditions of storage and transportation of pharmaceuticals, the volume of their stocks, forecasting the need for material resources and optimizing production; lack of paperless organization of production of pharmaceutical products.

Therefore, the need for digitalization of pharmaceutical logistics is determined by the requirements of both PMEs and healthcare institutions, for which the problem of reliability and uninterrupted functioning of pharmaceutical supply chains, ensuring the physical availability of drugs and the timeliness of their delivery to customers (clients) is actualized, especially in the conditions of epidemics and martial law, ensuring the transparency of PSC functioning and their protection against counterfeit products.

The implementation of DT in all areas of pharmacy fundamentally changes the content of business processes and the nature of interaction with clients and consumers. Thus, the digital transformation in the pharmaceutical industry determines ways of revising the existing PME business model, increasing the responsiveness of pharmacy to the challenges that determine civilizational development today. Such, in particular, are the growing volumes of digital information exchange, the need to increase the availability of pharmaceutical products in the conditions of the appearance of new diseases, etc. [8].

As the analysis of literary sources showed, the processes of digitalization of pharmaceutical logistics are influenced by various factors: the state of the PE digital infrastructure, the qualification of logistics personnel and their awareness of DT, the level of costs associated with their implementation, the effectiveness of the organizational structure of logistics activities at enterprises, the state of organizational culture [9–11].

DT is the main driver of digital transformation. Therefore, the availability and effectiveness of the use of these technologies in many ways determine the level of digital maturity (DM) of PE logistics activities.

GxP industry standards place high demands on the competence of PE personnel, as this factor directly affects the quality of all business processes and, accordingly, the quality of health care. Therefore, the appropriate level of digital literacy of logistics personnel is an important condition for the effectiveness of the logistics activities of PE and their DM.

Management of costs associated with the implementation of DT on PE is also of particular importance for the implementation of the digital transformation strategy, since their unjustified and uncontrolled growth leads to an increase in prices for pharmaceutical products and, thus, leads to a decrease in the affordability of drugs for end users.

The effectiveness of the implementation and use of DT on PE depends to a large extent on the quality of management of the processes of digitalization of logistics activities and, in particular, the digital competencies of management personnel. The assessment of the organizational structure of management allows us to answer the question of whether there is a position or department at the PE that is assigned the functions of digital management and, in particular, logistics activities.

A manifestation of DM PE is the effectiveness of digital channels of interaction with customers, who are considered as digital partners. The construction of such channels helps to satisfy the needs and requests of customers (consumers) as fully as possible, as well as to ensure the profitable activity of PE.

As you know, the active implementation of DT requires significant financial resources and investments, which actualizes the problem of their effective use, which largely depends on the validity of the PE's choice of digitalization strategy. It is not possible to choose an appropriate strategy for the digitalization of activities for a certain PE without a preliminary assessment of the DM level of the enterprise.

DM PE characterizes the level of implementation and development at the DT enterprise, the extent to which business processes are covered by them, the efficiency of using digital assets, the type of computer system used and data processing modes, which ultimately determine the enterprise's ability to quickly respond to changes in the surrounding environment and constantly improve its activity. That is, we can say that the level of DM is determined by the accumulated digital potential of PE, which determines the further strategy of digital transformation of the enterprise and the level of its effectiveness.

The main goal of the growth of DM logistics activities of PE is to create additional value for the consumer by increasing the physical availability of pharmaceuticals in the right city at the right time, increasing the quality of logistics service, reliability, timeliness and uninterrupted fulfilment of orders, reducing the risks of poor order fulfilment, increasing the transparency of the activities of pharmaceutical chain participants and the development of permanent partnership relations between them.

It should be noted that conducting a DM assessment provides PE with the opportunity to obtain specific advantages on the path of digital transformation of logistics activities, in particular: it allows a reasoned approach to determining the desired level of DM; form recommendations for choosing a strategy for the digital transformation of logistics activity, based on the conditions and features of a specific PE and the calculated integral indicator of the level of DM of the PE's logistics activity; identify unused reserves of digital potential, etc. It should be noted that, despite the relevance of the problem of assessing the DM level of logistics activities of domestic PEs, it has not yet been properly reflected in scientific sources, which determined the choice of the research topic.

The aim of the work – development of methodical approaches to evaluating DM logistics activities of PE and working out the proposed methodology on the example of those domestic enterprises that have a developed logistics system and some experience in implementing DT in logistics activities.

2. Planning (methodology) of the research

The following research plan was developed in order to achieve the specified research goal:

– to analyze and generalize the existing scientific approaches to defining the essence of DM of the enterprise and to determine the main advantages of PE functioning from increasing the level of DM of logistics activities;

– select PEs, based on which the proposed DM assessment methodology will be developed, based on a preliminary diagnosis of the existing level of DT implementation in their logistics activities since DM can only be discussed if the enterprise has a certain digital potential;

– according to the results of the study of scientific sources, determine appropriate indicators for diagnosing the existing level of digitalization of PE logistics activities;

– based on the results of systematization of results, critical analysis of modern approaches to determining the essence of DM of the enterprise and determining the advantages of PE from increasing the level of DM of logistics activities, develop methodical approaches to evaluating the DM of logistics activities of PE, as a diagnostic tool for the enterprise's readiness for digital transformation;

– to develop the proposed methodology at PE, which is a leader in the field of pharmaceutical logistics on the domestic market;

– based on the results of the development of the specified methodology, propose recommendations for improving logistics processes in pharmacy and increasing the reliability, safety, and efficiency of PSC activities.

An important component of the proposed methodology for assessing DM of PE logistics activities is the determination of the sequence of stages of its implementation (Fig. 1).

Next, we will consider in more detail the content of the stages of assessing the DM level of logistics activities at domestic PEs.

As already mentioned, based on data from the literature [12–14], the main factors that directly affect the success of the digital transformation of logistics activities of enterprises are determined, in particular: digitalization strategy, digital competence of personnel, organizational culture, DT, organization of sales activities, organizational structure of digital management. Therefore, to assess the level of DM of logistics activities of PE, first of all, it is necessary to assess the presence of a digitalization strategy at the enterprise and the degree of its integration with the logistics strategy.

Next, it is necessary to form a list of local indicators that should be used to evaluate the DM of PE logistics activities. It should be noted that the selection of indicators is one of the most responsible stages of the methodology since the accuracy and completeness of the DM assessment of the enterprise's logistics activity will depend on the completeness and rationality of their list. The list of indicators selected at the first stage of their filtering based on the previously conducted content analysis was used as the basis of the developed questionnaire. For the selection of indicators for further filtering, scientists, managers, and specialists of logistics services (departments) of PE were involved as experts.

According to the results of experts' evaluations, indicators are selected, the average rating of which has the largest number of points within each direction of research.

To form the final list of DM evaluation indicators of PE logistics activity, the pairwise correlation coefficient is calculated at the next stage. Indicators with a pairwise correlation coefficient of more than 0.9 are excluded from it. Values of pairwise correlation coefficients that are close to unity indicate the presence of a strong relationship. Values close to zero indicate either the absence of any relationship or the absence of a relationship of the type for which the corresponding coefficient was developed [15].

In the future, based on the calculations, the values of the weighting coefficients for the indicators characterizing the DM level of the logistics activity of the PE are determined.

The list of indicators for evaluating DM, which reflects the specifics of PE logistics activity, formed by the authors, includes:

1. According to the direction (component) of DM assessment "Strategy": existence of a clearly formulated digital strategy; the level of staff awareness of the digital strategy and its goals; considering the logistics component in the digital strategy, which involves the use of digital logistics tools.

2. According to the direction (component) of the assessment of DM "Personnel," the level of implementation of measures for the development of digital skills and abilities of logistics personnel; level of mastery/share of employees with basic computer skills.

3. According to the direction (component) of the assessment of DM "Organizational culture": the level of coordination and interaction of management levels during the digital transformation of logistics activities; availability of measures to overcome (prevent) employee resistance that arises in the process of digitization of PE logistics activities; the level of discrepancy between the digital competence of employees and the tasks they perform.

4. According to the direction (component) of the assessment of DM "Digital technologies": the level of providing the enterprise with computers and other equipment necessary for the normal functioning of logistics processes; the level of implementation of effective modern security systems for PE cyber security; the level of use of technologies of automated vehicles and drones, sensors and sensors that monitor the movement of pharmaceutical products online.

5. According to the direction (component) of the evaluation of DM "Sales logistics," the presence of a modern interface of the PE website, the use of SEO-optimization technologies, the level of use of digital distribution channels of pharmaceutical products, the availability of an application for mobile devices to improve the efficiency of work with PSC participants.

6. According to the direction (component) of DM assessment, "Structure": the level of flexibility of OSU and its ability to adapt to changes occurring in the external environment of PE (including changes related to the digital revolution); the level of use of modern architectures (API, cloud) to increase the speed and flexibility of PE work; the presence in the structure of PE of a position or department, which is assigned the functions of digital management.

To transform qualitative assessments (answers) of experts into quantitative indicators of assessment of DM of logistics activities of PE, it is advisable to use a three-level scale, according to which: a high assessment is equal to 1.5 points; average grade – 1 point; low score – 0.5 points.

At the fifth stage, based on the use of the Statistica software package, the integrated taxonomic indicator of the actual DM level of the PE logistics activity is calculated.

Next (at the sixth stage), an evaluation scale is substantiated for diagnosing the qualitative state of the DM of the logistics activity of the PE.

At the seventh stage, the desired (proper) level of local and integral DM indicators of PE logistics activity is determined based on a previously conducted analysis of the state of implementation of DT in PE logistics activity.

In the following (eighth stage), the gaps between the actual and the desired level of DM indicators of PE logistics activities are evaluated.

In the ninth stage, priorities for the implementation of DT in the logistics activities of PE are determined depending on the degree of their DM (Fig. 2). The diagram shown in the figure was built based on the proposals of the European Agency for Drugs [16, 17] and supplemented with the author's vision regarding the selection of priorities for the implementation of DT in the logistics activities of PE depending on the degree of their DM.

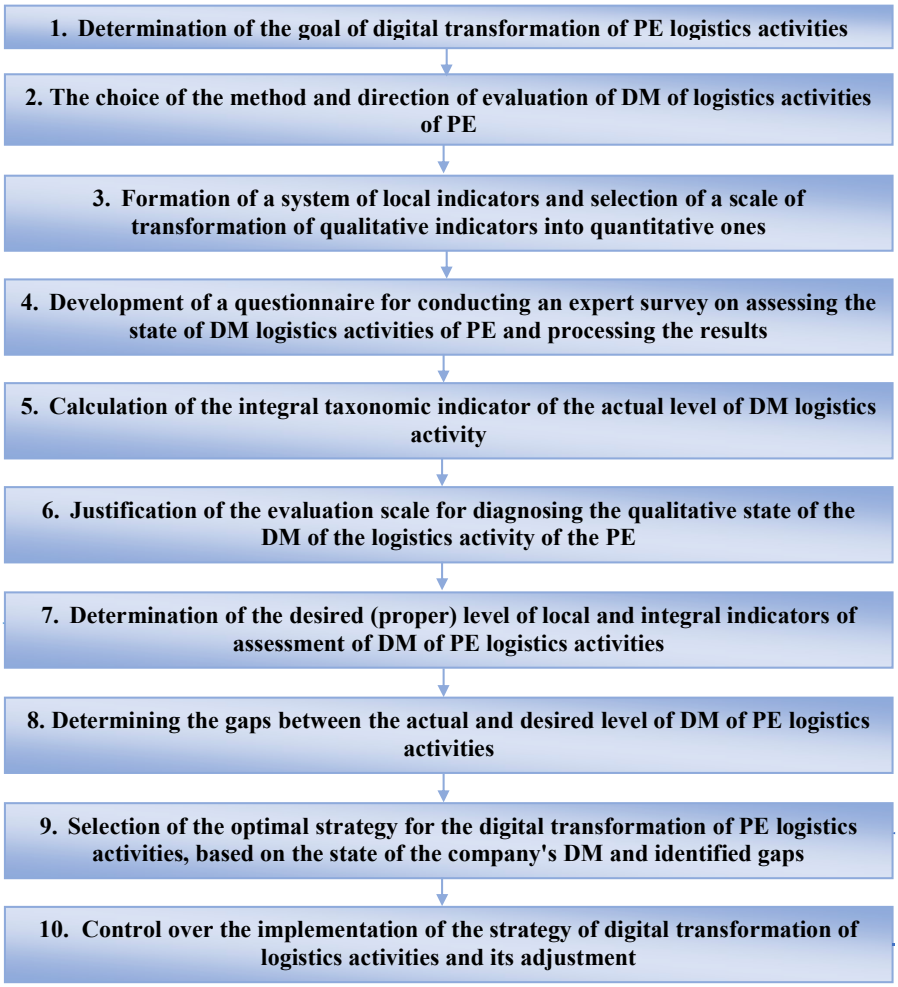

Fig. 1. The proposed algorithm for assessing the DM of PE logistics activities.
Source: own development

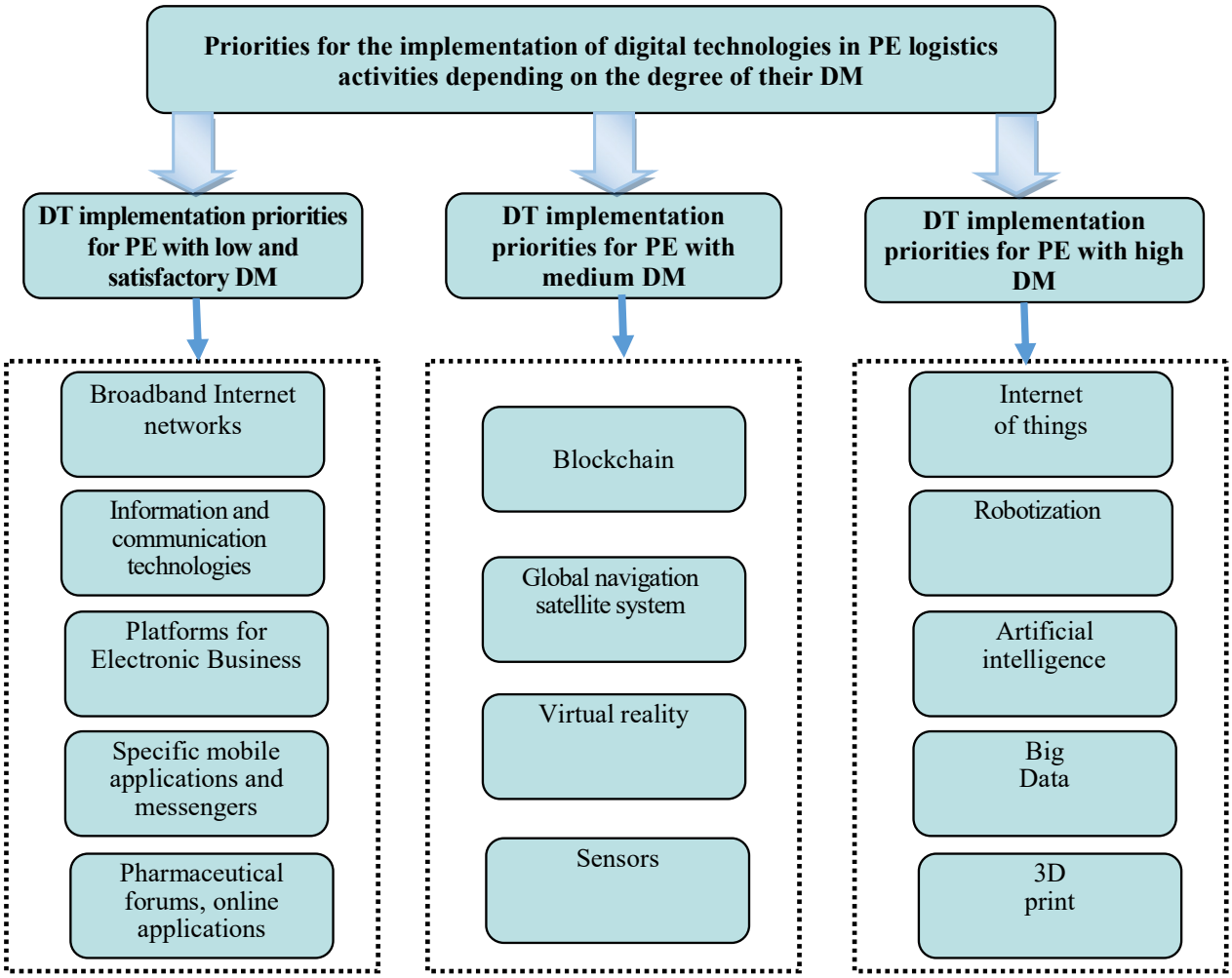

Fig. 2. Priorities of implementing DT in logistics activities of PE depending on the degree of their DM
Source: elaborated and supplemented by the authors based on [16, 17]

In the tenth – last stage, control over the implementation of the strategy of digital transformation of PE logistics activities and its adjustment is carried out.

3. Materials and methods

The research was conducted using databases on the Internet: the European Center for Information Systems Research, the European Medicines Agency, and scientific and metric databases – Scopus, Web of Science. The search was conducted using the following keywords: digitalization, digital maturity, digital technologies.

Research on the use of DT in domestic PEs is given as of 2022 based on data provided by the PEs under study. The evaluation of DM logistics activity was carried out on the example of the operation of such domestic PEs as PJSC "Pharmak", PJSC "PM Darnytsia" and LLC "PC Zdorovya". The choice of these PEs is justified by the fact that these enterprises have been the leaders in terms of sales of drugs on the pharmaceutical market for many years [18–20] and are also leaders in the field of pharmaceutical logistics.

When working out the existing approaches to DM assessment of PE logistics activity, logical and systematic methods were used, as well as methods of analysis and synthesis, with the help of which the essence of the digital maturity category of PME was investigated, the experience regarding digitalization of logistics activity was summarized, and DM assessment methods existing in domestic and foreign practice were elaborated enterprises.

A graphical method was used to visually present the results.

The expert method was used to assess the level of DM of PE logistics activities according to 6 predefined key components (directions): strategy, personnel, structure, DT, sales logistics, organizational culture. The collection of information was carried out by the method of a standardized expert survey. The formation of the group of experts took place with the involvement of representatives of the scientific field and practical pharmacy.

For the reliability and thoroughness of the research, we developed a model for determining the coefficient of expert competence, which allows you to assess the expert's competence based on the expert's professional level of knowledge in this field, considering his qualification category and practical experience [21, 22]. As an initial (target) variable when building the model, the assessment of the expert's awareness of the problem under study was considered, which, according to the questionnaire, had two possible values: fully satisfied need for information (1) and partially satisfied need for information (0).

Based on the results of the study, quantitative parameters were determined that affect the degree of awareness of experts on the investigated problem: total work experience, work experience by profession, age, number of subordinates, qualitative - position, scientific qualification, and form of PE ownership. The ranking of the input variables by the level of importance for determining the expert's awareness of the problem under study was carried out based on the calculation of the information criterion λ^2 (Table 1).

Table 1

Results of assessment of experts' competence indicators

Parameter	Value	
	Chi-square(λ^2)	P-value
Position	36.164	0.00122
Work experience in that position	27.142	0.00255
Total work experience	25.174	0.00216
Scientific qualification	21.183	0.00349
Age	13.647	0.00272
PE ownership form	12.395	0.00188
Number of subordinates	7.401	0.001592

Source: own development

According to the results of the assessment, 4 indicators were selected, which have the greatest informativeness: position, total work experience, work experience by profession, and scientific qualification. Other indicators were not included in the model for assessing the competence of experts, as they had low λ^2 values.

To build a model for assessing experts' competence indicators, the logistic regression method was used, which allows obtaining estimates of binary feedback in the form of a continuous function with a value from the interval [0; 1], which are interpreted as the probability that the target variable will take the value 1.

When building the model, various methods of estimating its parameters were tested. The best indicators were obtained using the quasi-Newton method and the Hooke-Leevesguasi-Newton method [23, 24]. Based on the calculated coefficients of competence, the level of experts' awareness of the investigated problem was qualitatively characterized in accordance with Harrington's verbal-numerical scale (Table 2).

Table 2

Harrington scale [21]

Graduation	Numeric interval
Very low	0.00-0.20
Low	0.20-0.37
Middle	0.37-0.63
High	0.63-0.80
Very high	0.80-1.00

More than 50 specialists who had more than five years of experience in the pharmaceutical industry and relevant professional education took part in the expert survey. The degree of agreement of experts' conclusions, which was measured using the concordance coefficient (W=0.908), can be recognized as high. The significance of the concordance coefficient was assessed by calculating the Pearson test ($\chi 2$) and comparing it with the tabular value for degrees of freedom n–1. Since the calculated value of $\chi 2$ significantly exceeds the tabular value, this confirms the non-accidental consistency of the experts' conclusions.

The method of pairwise correlation was used to form the final list of DM evaluation indicators of PE logistics activity in order to eliminate the phenomenon of autocorrelation.

In order to calculate the integral indicator of the level of DM of logistics activity of PE, based on the data of an expert survey and the subsequent transformation of qualitative assessments into quantitative ones, we used the methods of mathematical and statistical analysis (namely, the taxonomic method), which provides the opportunity to set and mathematically substantiate even such tasks for which there are no full-fledged statistics, or in the case when among the studied indicators there are only qualitative ones. The advantage of this method is also that it provides the possibility of adapting economic and mathematical models to the changing conditions of the enterprise's operating environment [25].

For a qualitative assessment of the calculated integral indicator of the level of DM of logistics activity of PE, we used the scale given in the Table 3, which allows, depending on the level of the calculated integral indicator, to identify the state of DM PE (low, satisfactory, average, high) and to determine the priority areas of digital transformation of logistics activities at a certain PE.

Table 3

The scale of quantitative and qualitative assessment of the level of DM of logistics activities of PE

Qualitative evaluation of the integral indicator of DM	Quantification of the DM integral indicator	DM status description
Low	0–0.25	PE is sceptical of DT and does not consider their impact on logistics activities seriously enough. The PE management examines only the practice of conducting digital transformation of logistics activities at competitors or other PEs
Satisfactory	0.25–0.50	PE is very slow to accept DT. The process of digital transformation of logistics activity stretches for a long time, and the digitalization itself is quite superficial and does not cover all areas of PE logistics activity
Middle	0.50–0.75	PE supports DT and invests in innovation and digital logistics. The guidance focuses on the implementation of DT, but there is no performance measurement and analysis of these innovations. Also, insufficient attention is paid to planning, development of digital strategy and formation of digital competencies of employees
High	0.75–1	PE uses all the possibilities provided by DT. The process of digital transformation is systemic and covers all areas of logistics activity. Innovations are monitored and evaluated, and a digital PE strategy is developed.

Source: elaborated and supplemented by the authors based on [21, 25]

4. Research results

The results of a preliminary express analysis of the evaluation of the implementation of DT in the logistics activities of the PE, conducted using open information sources and the sites of the investigated PEs and information provided by the PEs themselves, are shown in the Table 4. This preliminary analysis was carried out with the aim of diagnosing the sufficiency of the logistics potential accumulated at the studied PEs, which allows us to talk about the correct use of these enterprises as objects for approbation of the proposed DM assessment methodology of PE logistics activities.

Table 4

The results of an express analysis of the implementation of DT in the logistics activities of the investigated PEs

Directions for using DT	PJSC «Farmak»	PJSC «PM Darnytsia»	LLC "PC Zdorovya"
Use of computers and broadband Internet access	+	+	+
Availability of a single digital platform for the interaction of all PSC participants	+	+	+
Availability of specialized programs for managing PE logistics activities	+	+	–
Availability of technology without a documented flow of PE logistics activities	+	+	–
Use of «industrial» Internet of Things technology	+	+	+
The presence of a modern PE website interface, the use of SEO optimization technologies	+	+	+
Availability of information about PE logistics activities in social networks:	+	+	+
– social network Facebook	+	+	+
– social network Instagram	–	–	–
– social network Twitter	–	–	–
– YouTube	+	+	+
– chatbot at Telegram/Viber	+	+	+
Availability of an online application for smartphone users	+	–	–
The use of structured and unstructured large data sets and their significant diversity processed by software tools (Big Data)	–	–	–
Artificial Intelligence	–	–	–

Source: generated by the authors based on data provided by the studied PEs for 2022

The results of the express analysis show that the studied PEs have already accumulated a certain potential and experience in the use of DT, which opens serious innovative prospects for further improvement of logistics processes and the creation of conditions for ensuring the reliability, safety and efficiency of PSC activities. After all, access to DT creates significant advantages for all PEs, which makes it possible to build strategic partnerships, access support services such as training, finance, and legal services, reach different markets and different segments of drug consumers, which is critical when building a digital environment in the pharmaceutical industry.

The results of the quantitative assessment of the level of digitalization of logistics activities at the investigated PEs (PJSC "Farmak", PJSC "PM "Darnytsia", LLC "PC "Zdorovya") using local indicators traditionally used in scientific sources are presented in Table 5. According to the data it can be seen that the level of local indicators of the digitalization of logistics activities of LLC "PC "Zdorovya" is significantly lower compared to PJSC "Farmak" and PJSC "PM "Darnytsia" (almost in all areas). The highest level of local indicators is observed in PJSC "Farmak".

Table 5

Assessment of the level of digitalization of PE logistics activities using traditional local indicators

Indicators of assessment of the level of digitalization of logistics activities	PJSC «Farmak»	PJSC «PM «Darnytsia»	LLC «PC «Zdorovya»
Indicators of digital infrastructure			
The number of computers used in logistics activities on PE per 100 employees, pcs./100 people	37	21	11
Number of specialized programs for PE, pcs.	22	14	13
Indicators of material and technical supplement			
The share of equipment with Internet access in the total volume of equipment, %	2.58	1.06	0.88
The share of equipment with artificial intelligence in the total volume of equipment, %	0.05	0	0
Indicators of labor resources			
Share of employees with IT education, %	13.9	8.5	8.1
The share of employees who use digital technologies in PE logistics activities, %	5.6	4.9	4.6
Share of employees who have undergone digital literacy training, %	11.2	6.3	–
Financial indicators			
Share of spending on digital technologies in the total spending structure, %	7.7	3.4	2.6
The share of costs for professional development, training employees in digital literacy in the overall structure of costs for personnel training, %	46.2	63.1	–
Organizational and management indicators			
The share of managers with IT education in the management structure of PE logistics activities, %	6.1	3.5	4.6
The share of digital document flow from PE logistics activities, %	38	33	29

Source: generated by the authors

Therefore, the conducted analysis shows that the available material, technical and information resources for the digital transformation of logistics activities in domestic PEs are different, and this difference is largely due to the number of investments in DT and the level of provision of PE and staff with digital infrastructure, the level of digital competence of employees.

However, the obtained results do not provide a clearly defined generalized quantitative assessment of satisfaction (dissatisfaction) with the level of digitalization of PE logistics activities and are insufficient to form a systematic view of the state of DM logistics activities of a certain enterprise and the choice of further priorities for its development. The calculation of the specified local indicators allows to obtain only local comparative information regarding the state of DT use and does not provide an opportunity to draw conclusions regarding the presence or absence of a certain PE of the necessary digital potential for further digital transformation. To obtain a more objective and systematic assessment of the DM status of organizations, foreign scientists and consulting companies use various methods (Table 6) [26–32].

Based on the results of the analysis of the existing DM evaluation methods, it can be concluded that these methods have a structure that corresponds to the Capability Maturity Model Integrated and provide for the possibility of identifying bottlenecks for the digital transformation of the enterprise's logistics activities. However, they also have certain limitations that make them insufficiently effective for diagnosing problems and building a digitalization development plan for PE.

Table 6

General characteristics of the methods used in foreign practice for evaluating the company's DM

No.	Methodology developer	Characteristics
1	MIT Center for Digital Business and Capgemini Consulting [26]	Based on the analysis of more than 400 large enterprises from various industries, three key areas of digital transformation were formed: Transforming Customer Experience, Transforming Operational Processes and Transforming Business Models. Within each of the selected spheres, there are three complementary elements, and these nine elements form a set of building blocks of digital transformation. However, no enterprise completely transforms all nine elements at once. Different businesses move towards digital transformation at different rates and achieve different levels of success
2	Deloitte's Digital Maturity Model [26]	Digital capabilities are evaluated in 5 key areas: Customer, Strategy, Technology, Operations, Organization & Culture. The five main dimensions are divided into 28 sub-dimensions, which, in turn, are divided into 179 indicators by which DM is evaluated. Emphasis is placed on Business Strategy. Successive steps of specifying the strategy are the definition of Business Model and Operating Model
3	Digital Transformation Index, developed by an analytical agency, Arthur D. Little [27, 28]	It has a larger number of consolidated areas of assessment: Strategy and governance, Products and services, Customer Management, Operations and Supply Chain, Corporate Services and control, Information Technology, Workplace and culture. For each enterprise, the evaluation results are formed in the form of a radar, on which, taking into account the specifics of the industry, the Virtual Star level and the average industry level are also marked
4	Digital Business Aptitude (DBA) of the KPMG enterprise [29]	It combines 5 areas of assessment: Vision and strategy, Digital Talent, Digital First Processes, Agile Sourcing and technology, and Governance. As in the two previous models, each of the selected spheres includes several components. The evaluation results are formed in the form of radar; each evaluation sector has its own colour. A feature and advantage of this model is the self-assessment diagnostic tool, which is freely available. There are 2 levels on the radar for each area of assessment: for this enterprise and the average for all enterprises that have passed the assessment. Thus, a basis for comparative assessment is formed, which is very important for decision-making in the field of strategy selection and priority areas of digital transformation
5	Digitalization Piano developed at the initiative of IMD and Cisco Global Center for Digital Business Transformation [30, 31]	Similarly to 7 notes, 7 Transformation Categories are distinguished, which make up the most important elements of the value chain of the enterprise: Business Model, Structure, People, Processes, IT Capability, Offerings, Engagement Model. For each of them, a list of guiding questions has been developed, the answers to which can help to draw up a transformation plan. A feature of this model is the determination of the gap between the current and desired levels in each direction. At the same time, to obtain the effect, it is recommended to simultaneously transform several elements and technologies – the creation of musical chords
6	Methodology of the Ionology enterprise [31]	The Ionology company distinguishes 5 blocks of digital transformation changes: Strategy and culture, Staff and customer, Process and innovation, Technology, Data and analytics
7	Acatech Industry 4.0 Maturity Index [32]	Developed based on research carried out by the National Academy of Sciences and Technology of Germany. Four key areas of digital transformation are distinguished: resources, information systems, culture, and organizational structure. The evaluation method is somewhat more complicated than the one described above. The index is formed simultaneously in several areas. Selected directions are evaluated according to the stages of development of Industry 4.0 (informatization, connectivity, visibility, transparency, predictability, self-correction). In addition, corporate processes are analyzed in terms of five functional areas (development, production, logistics, service, marketing, and sales). Special attention is paid to the transformation of the organizational structure and culture. The main goal is to create a flexible, constantly developing enterprise

The conducted analysis proved the necessity of adapting (improving) the given methods for DM evaluation of PE logistics activities. The methodology improved and adopted by the authors provides for determining the DM level of PE logistics activity in 6 areas: strategy, personnel, structure, DT, sales logistics, and organizational culture using a system of indicators created for PE, selected based on two-stage filtering.

A scale was used to interpret the obtained results of DM assessment of logistics activity of PE based on the calculated integral indicator, which allows to determine the quality level of DM of logistics activity (low, satisfactory, middle, and high) and, according to the determined level of DM, to choose an appropriate strategy of digital transformation of logistics activity.

The results of the calculation of the integral DM indicator of the logistics activity of the investigated PEs are shown in the Table 7.

The assessment of the level of DM of the logistics activity of the investigated PEs using the improved methodology allows us to draw the following conclusions: LLC "PC "Zdorovya" has a satisfactory level of DM (0.274), which indicates that the PE really assesses the importance of using DT and their advantages in comparison with analogue technologies but is very slowly introducing them into logistics activities. The company devotes enough time and resources to establishing the structure of information communications, but it does not have sufficiently developed digitalization in the field of sales logistics and operational activities, and strategic planning needs to be improved in the context of the development of the digital economy.

Research results indicate that PJSC "PM "Darnytsia" has a satisfactory level of DM, as does LLC "PC "Zdorovya". The calculated value of the integral indicator DM of logistics activities is slightly higher compared to LLC "PC "Zdorovya" (0.366) but also indicates a limited digitalization of logistics activities, which does not cover all areas of PE activity. The enterprise has been diagnosed with a sufficient level of organizational culture, which allows hope that further digital change will be well received and staff resistance will be minimal. More attention should be paid to the development of a digital strategy and its integration with the overall PE development strategy. Attention should also be paid to identifying and building the digital competence and digital literacy of staff, as well as evaluating the prospects for using digital marketing tools.

Compared to other researched PE PJSC "Farmak" has an average level of DM logistics activity. The company skillfully uses the opportunities opened by the application of DT, has a digital strategy, and invests in this direction. Individual digitization activities can serve as an example for other PEs. However, the field of digital transformation of sales logistics also needs intensifying efforts.

As already mentioned, determining the DM level of PE logistics activity is necessary for the formation of a well-founded and consistent strategy for the digital transformation of logistics activities and the effective use of the resources necessary for this (Table 8).

Table 7

The results of the DM's expert assessment of the logistics activities of the investigated PEs

PE elements	Values for each subsystem		Integral index	
	Calculated value	DM level	Calculated value	Strategy
LLC «PC «Zdorovya»				
Strategy	0.268	Satisfactory	0.274 satisfactory DM level	Activating efforts and attracting the necessary additional resources to accelerate the digital transformation of logistics activities
Personnel	0.289	Middle		
Organizational culture	0.364	Middle		
DT	0.327	Satisfactory		
Sales logistics	0.241	Low		
Structure	0.374	Satisfactory		
PJSC «PM «Darnytsia»				
Strategy	0.283	Satisfactory	0.366 satisfactory DM level	Activating efforts and attracting the necessary additional resources to accelerate the digital transformation of logistics activities
Personnel	0.513	Satisfactory		
Organizational culture	0.427	Middle		
DT	0.384	Middle		
Sales logistics	0.494	Satisfactory		
Structure	0.428	Middle		
PJSC «Farmak»				
Strategy	0.525	Middle	0.621 middle DM level	Adoption of the best global experience in digitalization of logistics activities
Personnel	0.597	Middle		
Organizational culture	0.624	Middle		
DT	0.561	Middle		
Sales logistics	0.496	Local		
Structure	0.518	Middle		

Table 8

Matrix appropriate for the selection of strategies for the digital transformation of PE logistics activities depending on the level of the integral indicator of DM

DM level	Characteristic behavior	Strategy	The range of change of the integral indicator DM
High	PE demonstrate a high level of digitization	Development and implementation of an innovative strategy for digital transformation of logistics activities	0.75–1
Middle	PE implement DT	Adoption of the best global experience regarding the digital transformation of logistics activities	0.50–0.75
Satisfactory	PEs explore digitization	Activating efforts and attracting the necessary additional resources to accelerate the digital transformation of logistics activities	0.25–0.50
Low	PE ignore digitalization	Local implementation of digital technologies in PE logistics activities	0–0.25

5. Discussion of research results

Despite numerous studies [33–36] on the problems of digital transformation of the company's activities, its practical implementation remains quite problematic. Moreover, problems arise both in the field of building a theoretical and conceptual basis for the mechanisms of developing the company's digital strategy and in assessing its DM. In particular, the problems of choosing the factors of digital transformation to assess its effectiveness and considering industry specifics are significant.

The conducted analysis of the state of implementation of DT in the logistics activities of the investigated domestic PEs allowed us to conclude that the domestic pharmaceutical industry has already accumulated a certain potential and experience of using DT in the management of logistics activities of enterprises, which proves that PMEs understand the importance of using the advantages of digital transformation.

It has been established that the analysis and diagnosis of the DM level of PE logistics activities in Ukraine are currently not being carried out, as there are no methods of such assessment adapted to the specifics of PE logistics activities. It is the lack of such research that makes it impossible for PE to form a well-founded and consistent strategy for the digital transformation of logistics activities and the effective use of the resources necessary for this.

Based on these considerations, methodical approaches to DM assessment of PE logistics activities were developed and elaborated in the work. The proposed method considers the peculiarities of managing the logistics activities of PE in the conditions of digitalization and allows to abstract from the specifics of the organization of logistics business processes at different PEs. The peculiarity of the given method is that, unlike most other methods aimed at evaluating the DM of the enterprise, it allows you to evaluate the DM of the logistics activities of the PE. In addition, the methodology provides a structural approach to the assessment of digital transformations and is sufficiently comprehensive from the point of view of covering all aspects of the digital transformation of PE logistics activities. In addition to the traditional areas of assessment of DM of enterprises (strategy, personnel, structure, DT, organizational culture) provided in other methods, an important component of the proposed method is the assessment of DM of sales logistics, which is a critically important process for the implementation of the social function of PE – timely provision of the population with the necessary and quality medicines.

The improved and adapted to the specifics of the PE activity method makes it possible not only to determine the potential of their DM and readiness for the implementation of DT in logistics activities in order to increase the reliability, safety and efficiency of the logistics processes of both individual PE and PSC but also based on the calculation of the integral (taxonomic) of the digital maturity indicator and the proposed scale of qualitative interpretation of the level of this indicator to choose an adequate strategy for the further digital transformation of logistics activities. This will contribute to increasing the efficiency of investments aimed at the digital transformation of PE activities.

It is certain that the problems raised in this study do not reveal the whole range of issues related to the implementation of DT in PE activities and their impact on the efficiency of logistics processes of enterprises and the functioning of PSC. A complex of issues related to the development of an assessment of possible risks of digital transformation of the logistics activities of domestic PEs remains unresolved, which is a necessary condition for the formation of effective and safe PSCs.

The practical significance of the obtained results lies in the creation of a methodological basis for assessing the level of DM, which will contribute to the process of improving the management of the processes of digitization of the logistics activity of PE thanks to the well-founded choice of a digital transformation strategy corresponding to the potential of the enterprise.

Study limitations are caused by the difficulty of obtaining the amount of information necessary for their implementation, which, in most cases, is not pre-

sented in statistical reports and on PE websites, by the lack of investment resources that are needed for effective digital transformation of PE, which has a certain influence on the choice and effectiveness of the implementation of the corresponding strategies, as well as with the lack of methodical approaches to determine the desired state of DM PE.

Prospects for further research are related to the development of a road map for the digital transformation of the logistics activities of domestic PEs, which have different logistics potential and a controlled market share.

6. Conclusions

1. An analysis of the state of implementation of DT was carried out on the example of PE, which in recent years has been the leader of the domestic pharmaceutical industry. Based on the conducted analysis, it was concluded that the leading domestic PEs have already accumulated some experience in the use of DT; in particular, software has been implemented in the management of PE logistics activities. DTs are used in working with customers, and other DT measures are in place, demonstrating PME's understanding of the importance of taking advantage of digital transformation.

2. It is substantiated that the assessment of the level of DM is a mandatory prerequisite for conducting the digital transformation of PE. The methods (models) for DM assessment of enterprises existing in the world practice were analyzed, and the necessity of their adaptation for the purposes of assessing the DM level of PE logistics activities was determined.

3. The main areas of assessment of DM logistics activities of PE are determined: strategy, personnel, organizational culture, DT, structure, sales logistics.

4. An algorithm for evaluating the DM of the logistics activity of PE is proposed, which is adapted to the specifics of the pharmaceutical industry.

5. For the practical application of the DM evaluation method of PE logistics activity based on two-stage filtering, a system of evaluation indicators was substantiated, which were worked out on the example of three domestic PEs that have sufficient logistics potential and experience in implementing DT.

6. Based on the application of the proposed methodical approaches to the evaluation of the DM of the logistics activity of PE, the calculation of the integral indicator of DM of the logistics activity of the studied PE was carried out using the taxonomic method - PJSC "Pharmak", PJSC "FF Darnytsia", LLC "FC "Zdorovya". A scale is proposed for the defined zone of qualitative assessment of the level of the calculated integral indicator DM of the logistics activity of enterprises.

7. Based on the conducted quantitative and qualitative assessment of the DM level of the investigated PEs and the determination of the deviation of the actual level of their DM indicator from the desired state, a digital transformation strategy for each of the enterprises is substantiated.

8. The practical significance of the conducted research is to create conditions for more effective use of resources aimed at improving the logistics activities of pharmaceutical manufacturers, increasing their level of competitiveness, and ensuring sustainable development, which is an important factor in improving the pharmaceutical supply of the population in Ukraine.

Conflict of interests

The authors declare that they have no conflict of interest in relation to this research, including financial, personal, authorship, or any other nature that could affect the research and its results presented in this article.

Financing

The study was conducted without financial support.

Data availability

The manuscript has no associated data.

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Received date 23.05.2023
Accepted date 22.08.2023
Published date 31.08.2023

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